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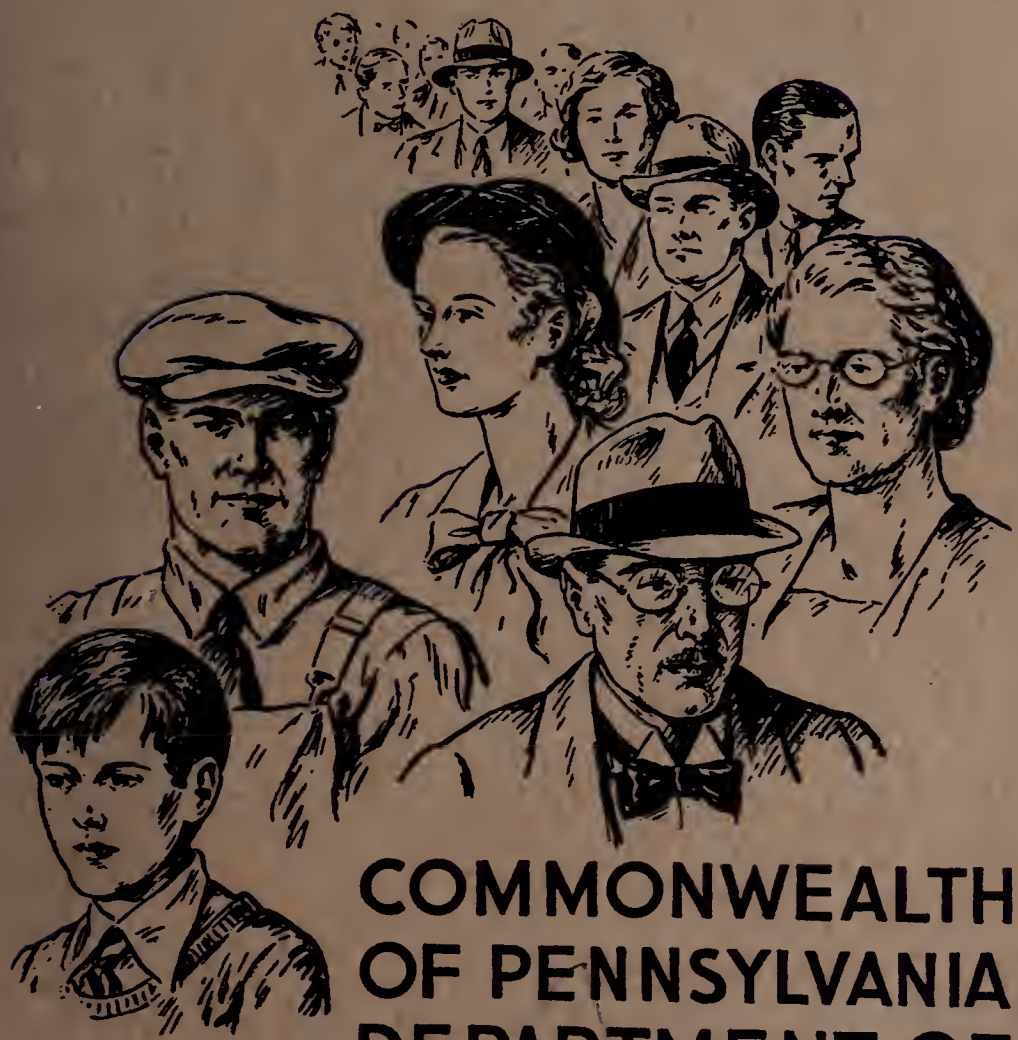
Technical and Business Institute Education

Bulletin 337

LESTER K. ADE
Superintendent of Public Instruction



COMMONWEALTH OF PENNSYLVANIA DEPARTMENT OF PUBLIC INSTRUCTION HARRISBURG 1939

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TECHNICAL and BUSINESS INSTITUTE EDUCATION

Bulletin 337

LESTER K. ADE

Superintendent of Public Instruction

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION
HARRISBURG
1939

FOREWORD

This bulletin describes an area of occupational instruction which requires a mastery of skills and a knowledge of techniques together with a background of general information which borders on professional competence. The area is distinguished from the skilled craftsman by the presence of at least elementary supervisory or directional functions. The classification is known variously as technical and business institute education, semi-professional education, terminal upper-secondary education, non-commissioned officers' education in industry and business.

Public education recognizes a number of areas of education for work: semi-professional, skilled, semi-skilled, unskilled, and rehabilitation of those who by nature or accident are lacking in some of the normal capacities.

Primarily because of limitation of funds vocational education in the United States, spurred on by special aid, has concerned itself almost exclusively with the numerically large and socially indispensable group of skilled workers. There are more than six millions of them. As additional funds are obtained more of these areas must be included in the scope of vocational education.

Excepting a few striking examples of non-profit institutions, the public schools have permitted proprietary education facilities largely to monopolize preparation for work in the semi-professional occupations. It is our belief that public education authorities should be encouraged to provide such opportunities for youth and adults.

In order to turn the experience of others to our advantage, a number of technical and business institutes in this country and abroad have been visited. High lights of these experiences are presented in this bulletin.

Mr. Robert H. Spahr, Director of Instruction and Curriculum Development in the General Motors Institute, who had served on a far-reaching survey of this problem financed by the Carnegie Corporation, was invited to work with us. He prepared and presented the material in Part I of this bulletin to a conference of school and industrial leaders invited to Harrisburg for this purpose. This report offers as a background a number of studies with surprisingly similar conclusions, conducted in different sections of the United States. It relates specifically to the opportunity for technical institute education in Pennsylvania and presents data which support the contention that an expansion beyond the existing offerings in the secondary school is a vital need in our educational system.

On the program with Mr. Spahr, Dr. Gerald D. Whitney, Associate Superintendent of Schools, Pittsburgh, Pennsylvania, and Mr. Bishop Brown, Chief of Business Education in the Department of Public Instruction, contributed from their experience. Dr. Walter B. Jones, Chief, Industrial Education in the Department of Public Instruction, and Doctor Whitney, had made recent visits to technical institutes in northern Europe. Doctor Whitney's discussion of

Scandinavian education at the conference and the visits referred to, suggested the second part of this bulletin. Mr. Brown's contributions were timely and his remarks and other pertinent information will be furnished on request. At the conclusion of the program, Mr. H. P. Hammond, Dean of the School of Engineering, Pennsylvania State College, gave a synoptic view of technical institute education, which is also incorporated in Part I of this bulletin.

Part II of the bulletin is a description of a successful technical institute in northern Europe, published in the Danish Foreign Office Journal. Typical of many such institutes in northern Europe, this non-profit institution has made a distinct contribution in the occupational area which it serves.

This bulletin was written under the direction of Dr. Walter B. Jones, Chief of Industrial Education, and Dr. Paul L. Cressman, Director of the Bureau of Instruction.

LESTER K. ADE
Superintendent of Public Instruction

March, 1939

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Technical and Business Institute Education

INTRODUCTION

In the late twenties and early thirties an international study of technical institutes was conducted as a collateral project to an extended investigation of engineering education, then being made by the Society for the Promotion of Engineering Education.

Funds for this study were provided through the generosity of the Carnegie Corporation of New York, and by a group of individuals and institutions, directly interested in determining the facts, both pros and cons, in connection with what had been called technical institute education.

The report of findings, "A Study of Technical Institutes," was completed by the staff in 1931. It was published the same year by the Lancaster Press, Lancaster, Pennsylvania, and may be obtained from this source at the price of one dollar, including postage.

From time to time, since the publication of the report, "A Study of Technical Institutes," in 1931, additional data have been collected, analyzed, and reported by the members of the original staff, both individually and collectively.

In the main, the members of the original staff have found no facts to date that would necessitate changes or even revisions of the conclusions reached in 1931.

Conditions in Pennsylvania at the present time point to the need for technical and business education chronologically beyond that now offered in the present day school and evening school, to provide vocational preparation for youth who are destined to serve in supervisory and semi-professional capacities in business and industry.

It was believed that the "Study of Technical Institutes" referred to would suggest at least a partial solution to the problem. Accordingly Mr. Robert H. Spahr, Director of Instruction and Curriculum Development of the General Motors Institute of Technology, a member of the staff of the "Study," was invited to present the findings of the study with any subsequent modifications which seemed to him pertinent. A conference of interested persons was called in November of 1938 to hear the report and discuss the question.

In addition, foreign experience with technical education was drawn upon for what contribution it might make. Both Dr. Walter B. Jones, Chief of Industrial Education in the Department of Public

Instruction, and Dr. Gerald D. Whitney, Associate Superintendent of Schools, Pittsburgh, had made recent visits to the schools of northern Europe and had been impressed with technical institute education there. Consequently an account of one of these typical schools is made a part of this bulletin. Direct application of practices abroad is not advocated, although successful adaptations of many of their techniques to American conditions may be possible.

Mr. Spahr's contribution follows as Part I of this bulletin. A discussion of the technical institute, by Dean Hammond of Pennsylvania State College, is also included here. A description of a technical institute in Copenhagen, Denmark, typical of many such schools in northern Europe, is presented in Part II.

I. TECHNICAL INSTITUTES IN THE UNITED STATES

A. NEED FOR TECHNICAL AND BUSINESS INSTITUTE EDUCATION ON UPPER SECONDARY LEVELS (Grades XIII and XIV and classes for adults)

In today's presentation, facts and findings will be used to the maximum and personal opinions to the minimum. At this conference are persons who represent both public and private education, who come from every section of the State of Pennsylvania, and who are admirably qualified to analyze, to evaluate, and to synthesize Pennsylvania's educational needs.

Our American education is a composite of many views and influences. On the whole, American education has proved satisfactory; it has justified itself. Yet, as we study it more closely, we recognize that certain fields have been developed out of proportion to other fields which have been neglected almost completely.

1. SHORTAGES IN PRESENT EDUCATION

In discussing certain gaps and shortcomings in our past and present educational systems, it must not be construed as destructive criticism of that which has been favored, but as a consideration, at least, for that which is *desirable yet undeveloped.*

For example, in the field of higher education, we have assumed, somehow, that courses of the same length, four years, of practically "standard" content, taught in largely the same way, should supply all of our needs equally well. Is this a sound and correct assumption?

If four is the right number of years to prepare for all kinds of gainful occupations, if the contents of the usual four-year college programs are the right kind for a wide diversity of employments, as well as for the various bents of individuals, then it would be well-nigh criminal to confuse the issue by even suggesting a more widely diversified educational program; it would complicate rather than clarify our problems.

2. DIVERSE EDUCATIONAL FACILITIES NEEDED

On the other hand, world experience together with data evolved from numerous studies in this country indicates the definite need for a wider diversity of educational facilities in the United States.

Particularly is this true in our great present industrial areas as well as in the areas with fair promise of becoming industrial. However, we must not forget that diversification may also be carried to excess, thus causing a blurring of aims and a lack of concerted and united effort.

Our educational problems call for both analysis and synthesis of a high order—an analysis of the past experiences and results, a study of the present status, and from these an effective, virile, and well-organized program for the future.

In education, the programs of today must prepare for the needs of tomorrow; years must pass before the effects of school programs or curriculums are felt actually in life and in practice.

Thus, our edueational programs, methods, and objectives need the carefully-studied and well-considered continuous revisions and adjustments for progress.

3. ADAPTATION OF PROVED PLANS SUGGESTED

There seems to be little on the horizon, even in the present uncertain times and in our apparent educational needs to indicate that our curriculums and offerings need to be stampeded into uncharted directions to meet the whims and fancies, when we might find solution for many of our problems and needs by skillfully *adjusting*, *adapting*, perhaps *combining*, tried and proved plans, methods, and practices to fit local conditions. There is a great deal to guide us if we will but use it intelligently.

Let us look at typical paths (not drawn to scale to indicate numbers in each path) followed by our young people, through formal schooling, to gainful employments, Fig. 1. It becomes quite apparent where potential opportunities lie in our educational picture.

The four-year college in America has been the goal towards which a large part of our edueational preparation has been pointed. Indeed, the yardstick by which many secondary schools measure themselves is the percentage of their graduates entering the four-year colleges.

Suppose that we choose six secondary school students at random. The secondary school has given these six students very nearly the same preparation that approximately one of them will use directly upon entering a four-year college; five of these six terminate their formal schooling with the secondary school and "seek" careers.

Even should these five who terminate their formal schooling with the secondary school find employment relatively soon after termination, is their preparation as direct and applicable as it might be for effective living? Also, for these five, two changed factors give us something to ponder carefully.

4. EMPLOYMENT AGE ADVANCING

First—whether we like it or not, whether it is socially sound or unsound, whether it is economically desirable or undesirable the age at which our young people are able to obtain employment is moving upward; on the average, it is very difficult for the person of from eighteen to twenty to obtain employment.

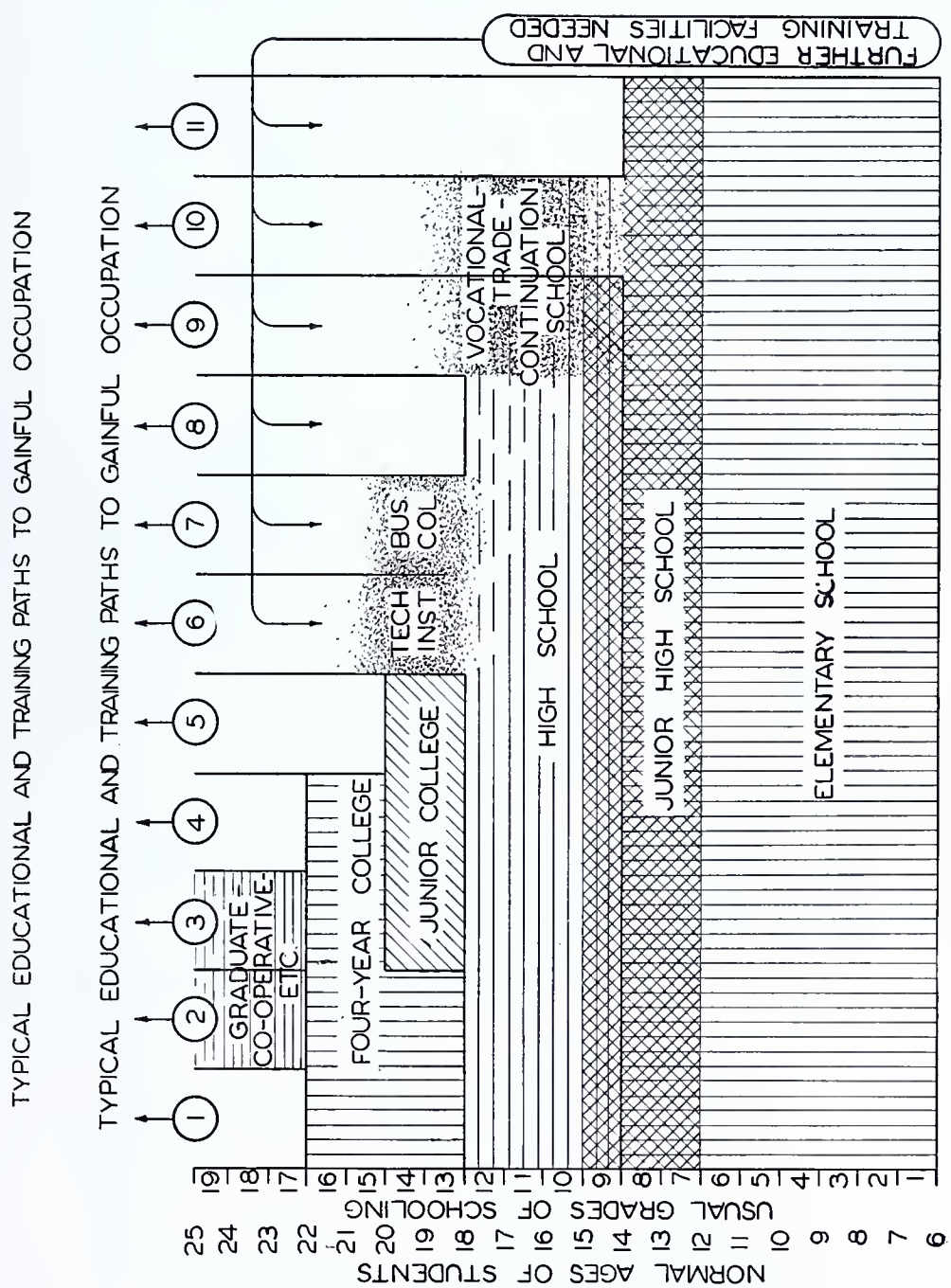


Figure 1—A representative picture of available American education, together with typical paths (not drawn to scale for number of persons following each) used by young people, through formal schooling, to enter gainful occupations.

If this person from eighteen to twenty years of age cannot find employment, and the chances are definitely against him finding it, then what? Department of Justice figures for recent years show that the largest number of arrests made in our cities occur at the age of nineteen. Should this fact have a bearing upon our educational plans?

This moving-up of the employment age is creating a situation that will undoubtedly sacrifice lives by the thousands upon the altars of indifference and crime: we are already reaping the harvest from our lack of foresight and perhaps of neglect in some instances.

It would seem logical to believe that the right kind of educational offerings for many of the post-senior high school people, particularly from eighteen to twenty, Fig. 2, would not only save lives from crime and indolence, but at the same time fit many for lives of honesty and usefulness.

5. FOUR YEAR COLLEGE NOT ONLY ANSWER

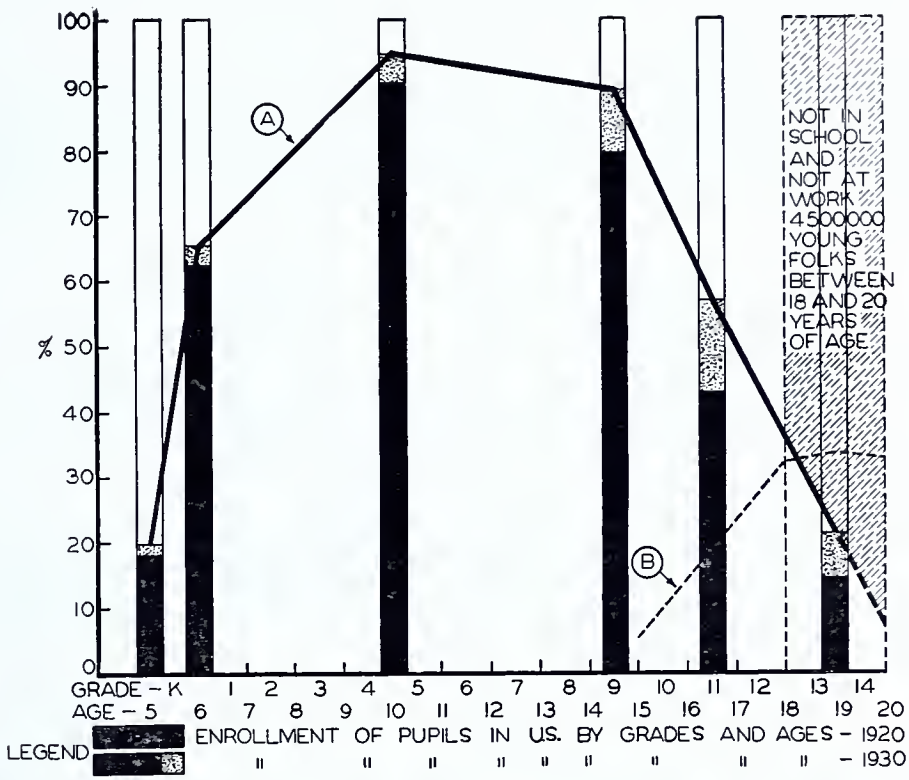
Second—there is an ever-growing desire on the part of parents to have all of their sons and daughters attend the usual four-year college. Many of these not only cannot, but should not enter the four-year college; many of them are not fitted mentally, temperamentally, vocationally, or otherwise to succeed there.

Bearing upon the need for larger diversification of educational facilities, might we be permitted to wonder why from fifty to sixty per cent of those who begin the usual four-year college course fall by the wayside—in other words, fail to reach completion of fond objectives had at the beginning of their respective courses?

The five out of the ten average ambitious youths entering the usual four-year college, with supposedly the required preparation, who drop out between entrance and graduation, are seemingly the "forgotten men," except in endowment campaigns; these five follow the programs designed for the five who remain—that is, preparation largely for more advanced subjects.

Since five out of the ten average ambitious youths entering the usual four-year college fail to reach their desired goal of graduation, to what causes might these failures be attributed—

a. Available curricula?
b. Student selection?
c. Lack of guidance?
d. Course and subject content?
e. Instruction methods?
f. Mentality or health?
g. Vocational bents and interests?
h. Economic problems?
i. *Etc., Etc.*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NOT IN SCHOOL AND NOT AT WORK 4500000 YOUNG FOLKS BETWEEN 18 AND 20 YEARS OF AGE
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AGE – 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
LEGEND
ENROLLMENT OF PUPILS IN U.S. BY GRADES AND AGES – 1920
" " " " " " " " " " – 1930

Figure 2—When pupils terminate their formal schooling.

Curve A shows the percentages of the various age groups, both attending and not attending formal school of any kind. Since these percentages for the various age groups above Curve A are not in school and relatively few of them are working, the question naturally arises: Where are they and what are they doing?

Curve B shows the distribution of percentages, by ages 15, 16, 17, 18, 19 and 20, of those in the United States who were arrested in 1935 for some crime or other. It is significant to note the rapid rise in crime frequency during the same ages in which there is a rapid decline in school enrolment, and also the fact that age 19 is the peak crime year, at this time, of the entire life span.

6. CONSIDER TECHNICAL COURSES

Would more consideration of the briefer "terminal" and "carcer" courses or of more adaptable programs assist in solving some of our current problems in education and preparation, resulting in larger effectivcness for our youth seeking employment, for those employing our youth, and for the community as a whole?

The authoritative answers to such questions should come from those directly affected and from those with experience in these courses and programs—principally, from employers and graduates.

As a rule, that which will be good for these two groups will be good for the community.

Do employers want "terminal" and "career" education and preparation? Relatively recent studies and analyses have indicated that, for balance and effectiveness in industry and business, certain ratios should exist in the numbers educated in the various types or fields of education.

7. WHAT DO MANUFACTURERS SAY

Thus, forty-eight manufacturing companies, located in an industrial state, were asked—

"How many positions are there in your establishment for which you prefer personnel with education beyond that offered by secondary schools in the following basic or technical fields?"

The basic or technical fields included mechanical, electrical, structural, chemical, mining, and miscellaneous jobs.

The needs of these forty-eight manufacturing companies indicated a ratio of two and eight tenths technical institute (beyond senior high school and less than four-year college) men to one man with four-year college education or beyond.

8. HOW MANY TECHNICAL GRADUATES NEEDED

Another question was prepared and presented to twenty-one companies in the same state—

"In order to maintain the efficiency of your organization, what percentage of your employes ought to possess a technical education of each of the following types?"

The results from this question indicated a need for two and seven-tenths technical institute men to one four-year college man.

In order to cover the needs of business and industry more comprehensively, the question was asked of the public utility companies in New Jersey. A need for two and seven-tenths technical institute men to one four-year college man resulted from this study.

A study in California of twelve business and industrial companies, conducted about the same time, indicated a need of two and six-tenths men requiring two years of education to one man requiring four years of education.

Another check was made as follows—technical "Positions Vacant" advertised in the New York Sunday Times, over a period of several months, were classified into two groups believed to require two and four years of education respectively. This resulted in a ratio of three to one.

It appears significant, almost incredible, to find five ratios, resulting from five studies conducted at slightly different periods under different circumstances in different industries, even in different parts of the country, so nearly alike.

9. THREE TO ONE RATIO

Thus, it may be safely concluded that business and industry can use effectively about three times as many persons with technical institute education as with four-year college education.

The technical education needs of industry were demonstrated further in a study of five major industries:

	Plants Covered	*Employes*
Chemical Industry	142	35,000
Electrical Mfg. Industry	149	153,000
Metal Trades	318	106,500
Paper and Pulp	156	35,000
Rubber Industry	113	100,000
	878	429,500

Out of the analyses of these industries came certain rather significant facts in connection with education.

Of these five industries, the electrical manufacturing industry seems now to be the most highly recruited with college educated men; even at that, only one out of every two men in its *technical* and *supervisory forces* has had education beyond senior high school.

Of these five industries, the metal trades industry appears to be the least highly recruited with college educated men; only about one out of every five men in its *technical* and *supervisory forces* has any college education at all.

In American industry, fifty-two per cent of the *presidents* and seventy-two per cent of the *technical* and *supervisory forces* have not had schooling beyond senior high school; might not industry's record be enhanced by greater educational opportunity for supervisory forces?

It appears quite apparent that the educational saturation point has not yet been reached in business and industry; however, it does not mean that those in official positions who do not have this higher schooling will be dismissed or demoted to make places for those more highly schooled unless the latter fail to produce equal results.

Do American employers recognize the need for post-senior high school education? "Is there need for technical institute education in New Jersey?" was asked twenty-one industrial companies in that state, with this result—Yes, 18; Uncertain, 2; Unanswered, 1.

From the public utility industries in New Jersey, the replies to this question were "yes" 100 per cent.

10. OBJECTIVES OF TECHNICAL EDUCATION

In addition to the American employers designating their education needs, they have suggested objectives for technical institute or career education as follows:—

A. To qualify people for supervisory positions in operating departments.
B. To qualify people for technical services, such as drafting, designing, testing, inspecting, setting standards, building technology, etc.
C. To qualify people with some specific semi-professional skills in such fields as art, accounting, banking, real estate, merchandising, public activities, etc.
D. To qualify people for commercial positions relating to the sale and distribution of products and services.
E. To supply facilities for adult initial education or re-education, or upgrading in their present work.

To sum up the educational needs—the present and the desired status of prepared men in employment indicates the felt needs of the industries of the country for their supervisory and technical forces—

Education	*Present Status*	*Desired by Industries*
Tech. Inst. or Career	0.8%	46.0%
Four-Year College	13.0%	17.0%
From Ranks and Other Sources	86.2%	37.0%
	100.0%	100.0%

From the studies of four-year engineering education in the twenties, there appears to be a missing link in our American educational offerings. In the post-senior high school levels, the usual four-year college had come to be one of our clearly defined institutions of learning.

11. INSTITUTES VS. COLLEGES

While several hundred junior colleges had already appeared in this country, the type of institution known in Great Britain as the "local technical institution" and that known in certain parts of continental Europe as the "technical middle school" and in other parts as the "institute of technology" had only a few counterparts in America.

These counterparts in America were represented by some thirty technical institutes, located principally in the northeastern part of the country, and significantly in our larger industrial sections. The study of these technical institutes revealed many interesting and important facts.

Their courses were found to be, in general—

More practical in aim and more direct in method than the usual instruction of the four-year colleges.

More advanced in character than the instruction commonly given in secondary schools and trade schools.

Distinctly technological, industrial, or commercial in content.

Shorter in duration than a four-year college course, but not less than one school year in length.

Closely related to the student's present or prospective field of employment.

Comprised of a curriculum of related subjects, organized as a terminal course rather than one preparatory for more advanced courses.

Not confined exclusively to a single technical branch, but including related scientific or liberal subject matter.

12. IS TECHNICAL EDUCATION EXPENSIVE?

Annual fees or tuitions for technical institutes—

Bliss Electrical School	$850	(a)
Chicago Technical College	$294	
Milwaukee School of Engineering	$395	
New Bedford Textile School	$ 5	(b)
New Bedford Textile School	$155	(c)
Ohio Mechanics Institute	$105	(d)
Ohio Mechanics Institute	$305	(e)
Pratt Institute	$159	
Rochester Mech. Institute	$150	
Wentworth Institute	$103	

Legend: (a) Includes board. (b) Residents of Massachusetts. (c) Non-resident Americans. (d) Engineering. (e) Power laundry.

Annual fees or tuitions for publicly controlled junior colleges, grades XIII and XIV, in the U. S.—

71 or 37.6% charge no tuition.
118 or 62.4% charge tuition, up to $200.

189

Close to 50% charge $100 or more.

The public junior college, grades XIII and XIV, in the U. S., is usually considered and administered as a part of secondary education included within the common school system, yet it is significant that 62.4% of these schools charge tuition.

The free tuitions are largely in California, Kansas, Mississippi, and Oklahoma.

Operating costs for private technical institutes—

Five day institutes submitted their operating costs, none of which included interest and amortization of plant investment, as follows:

	Min.	Aver.	Max.
Students Costs per Year	$275	$370	$450

Operating costs for junior colleges—

Investigation of published data on operating costs for the junior colleges shows a wide variation which scarcely appears safe to use for an individual case, by reason of non-comparable accounting and other pertinent factors. Some of these student costs per year have

been given as $188, $234, $300, $200, $232, $205, $230, $212, $213, $172, $224, $237, $238, $242, $261, $272, $278, $295, $329, $335, $369, $452, $251, $342, $321, $314, $284, $285, $161, $238, $196, $148, $116, $110, etc.

Operating costs for engineering education in four-year colleges, for comparison—

		Min.	Aver.	Max.
9	Polytechnic Institutes	$264	$571	$712
10	Endowed Universities		582	
4	Schools of Mines		595	
10	State Universities		399	
7	Land Grant Colleges		385	
45	Four-Year Colleges		486	

Available figures on operating costs—

After examining studies of operating costs in various fields of education and in both public and private institutions, and also from different costing systems, it is believed that with average conditions effective technical institute or career education can be given in the grades XIII and XIV under the public educational system for an operating cost of about $250 per student per year.

Range of instructors' salaries in technical institutes, in one analysis—

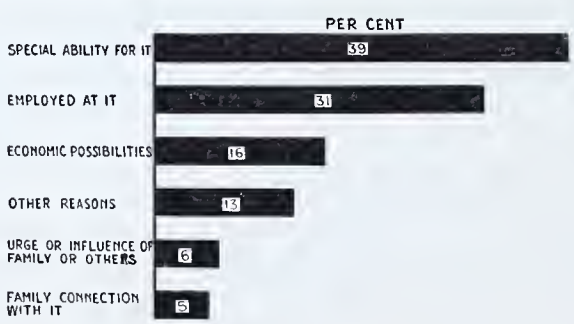
2	$1900 or Less	5	$4000—$4499
14	2000—$2499	5	4500— 4999
6	2500— 2999	2	5000— 5499
11	3000— 3499	2	5500— 5999
7	3500— 3999		

13. WHAT DO GRADUATES SAY?

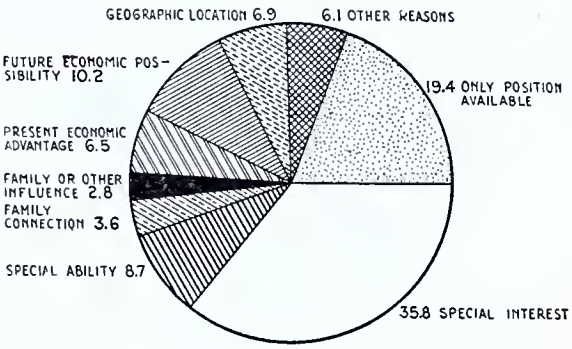
Students' objectives in entering the technical institutes—

A study of 629 technical institute graduates from 6 technical institutes indicated that at the time they entered the institutes, 68 per cent had a specific field of work in mind for which they expected to prepare; in other words, there was a definiteness of objective or a highly vocational aim.

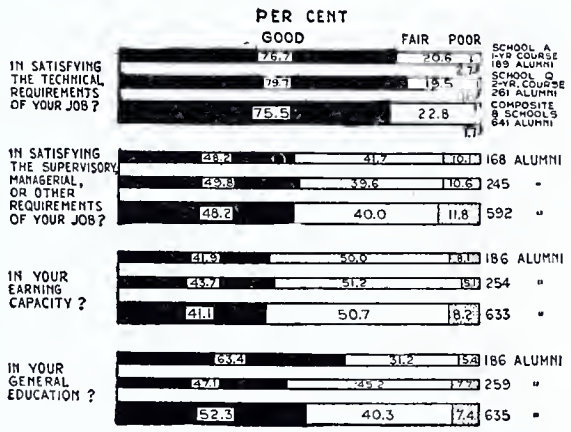
Chief reason for students' training for a specific field of work at time of entering a technical institute:



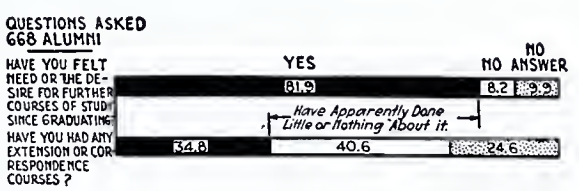
Main reason for student's choice of first position after institute graduation:



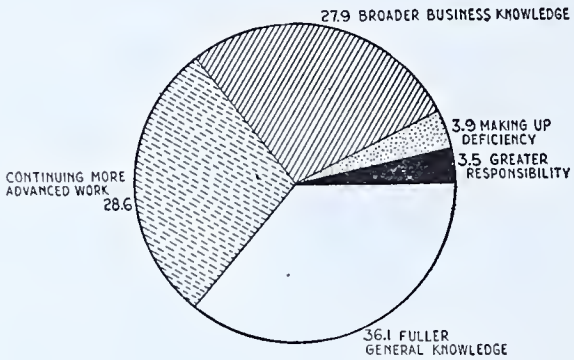
Extent to which technical institute course has met expectations of graduates:



Need or desire for further study by technical institute graduates and what they have done about it:



Reasons for needing further courses:



Earning chart

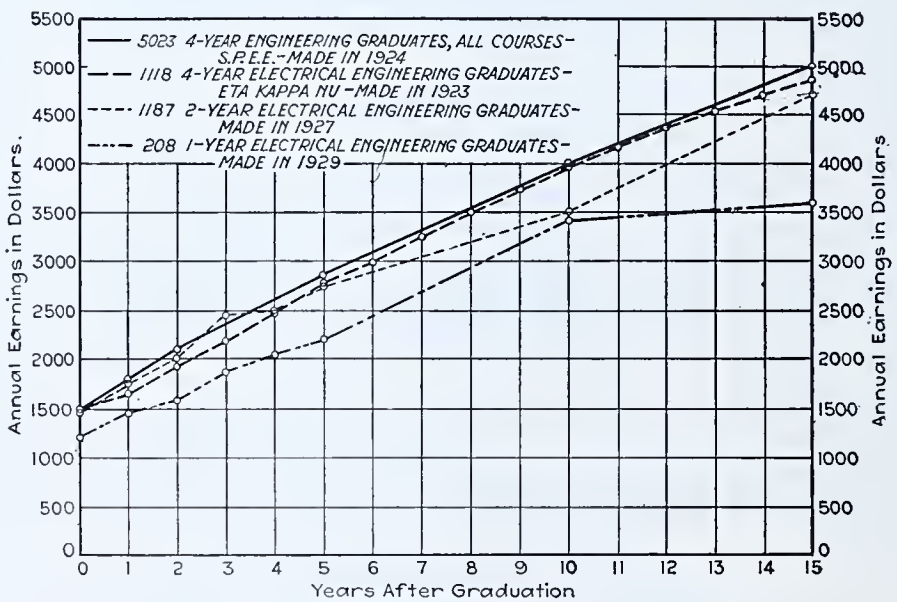
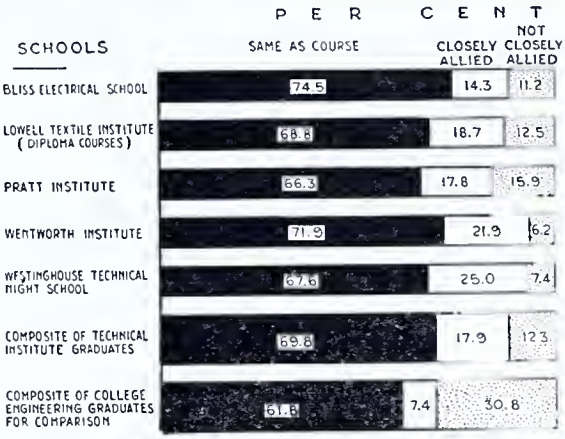

5023 4-YEAR ENGINEERING GRADUATES, ALL COURSES- S.P.E.E.-MADE IN 1924
1118 4-YEAR ELECTRICAL ENGINEERING GRADUATES- ETA KAPPA NU -MADE IN 1923
1187 2-YEAR ELECTRICAL ENGINEERING GRADUATES- MADE IN 1927
208 1-YEAR ELECTRICAL ENGINEERING GRADUATES- MADE IN 1929
Annual Earnings in Dollars.
Years After Graduation
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Figure 3—Comparison of earnings of graduates of one, two, and four-year engineering courses.

Relationship of fields of work of graduates to courses taken:



CONCLUSIONS

General Conclusions—In order to justify the further development of a relatively new type of education in America, even though gaps and shortcomings are known to exist in our present system, this new type must meet certain tangible and practical specifications, such as—

A. That it must furnish employers with persons effectively prepared for positions of importance and responsibility.

B. That these graduates must be equipped to fill such positions with equal or greater degrees of success than those in existing types of education.

C. That it must possess advantages over those types already functioning for certain types of minds, vocational bents, or individual desires.

D. That persons prepared must have a fair chance to live lives of usefulness, enjoyment, and completeness.

E. And, that it must not lead into a "blind alley," or that we do not overlook our American heritage that the door must not be closed to any person who finds a need to improve his position in life, whatever that position may be.

Thus, on each of the above counts the staff on the study of technical institute education could conscientiously render but one verdict —that of approval—and therefore recommend it as an effective form of education to meet many of the needs of employes, employers, and communities.

There is no warrant, at this time, for establishing a four-year college in every industrial or business center; we do not need more four-year colleges, whereas a technical and business institute or similar institution might thrive in most cities or centers of 50,000 population or more.

The actual needs and potential demands are beyond the resources of voluntary and private agencies, although the latter will have important contributions to make.

The smaller cities or centers of less than 50,000 would find it impracticable in most instances to maintain municipal institutions of this kind. Thus, if this gap is to be filled, it must be done largely by the states.

In the main, general and community needs are community responsibilities. Preparation for the more individual and specialized occupations such as horology might be the responsibility of state or private school located in a few strategic centers. Very highly specialized and individualized preparation normally becomes a private responsibility.

The actual needs of the country could not be adequately met by less than 250 such schools; this would seem to call for a great chain of community institutions having an organic place in city and state educational systems, yet free to achieve their own distinctive character.

There appears to be no necessity for limiting these institutions strictly to the kind of post-senior high school education usually found in our schools. Short unit courses, both full-time and spare time, for adults could and should be included.

The essential thing, however, is that the technical institute, or by whatever name it may be called, shall be a distinctive type of institution with clear cut purposes and specialized direction, and should not be throttled by the regimentation of the usual four-year college requirements or should not be tinged with the comprehensiveness of the present-day senior high school.

B. PENNSYLVANIA'S POSSIBILITIES FOR UPPER SECONDARY CAREER EDUCATION

(Grades XIII and XIV and classes for adults)

This morning we looked at the apparent needs for Technical Institute education in the United States. Now, we shall return home and consider some of the possibilities for Pennsylvania.

At the time the international study of Technical Institutes was made, in the late twenties and early thirties, six sources were found in Pennsylvania where the Technical Institute type of education, *in some form or other*, was available.

1. TECHNICAL INSTRUCTION IN PENNSYLVANIA

These sources were—

The College of Industries
Carnegie Institute of Technology
Pittsburgh

The Philadelphia Textile School
Philadelphia

The Evening Diploma School
Drexel Institute
Philadelphia

The Engineering Extension Division (in industrial centers)
Pennsylvania State College
State College

The Westinghouse Technical Night School
East Pittsburgh

The International Correspondence School
Scranton

Since that time, several of these sources have changed their offerings. Since this study was made, however, a new private Technical Institute has come into being in Pennsylvania—The Wyomissing Polytechnic Institute, Wyomissing (Reading).

WYOMISSING POLYTECHNIC INSTITUTE

The Wyomissing Polytechnic Institute offers three types of programs—

Wyomissing Polytechnic Institute (Endowed)

The Technical Inst. Program
a. Enrollment 1936-37—133
b. Tuition $80
The Junior College Program
a. Enrollment 1936-37— 50
b. Tuition $80
The Evening School Program
a. Enrollment 1935-36—610
b. Tuition $ 0

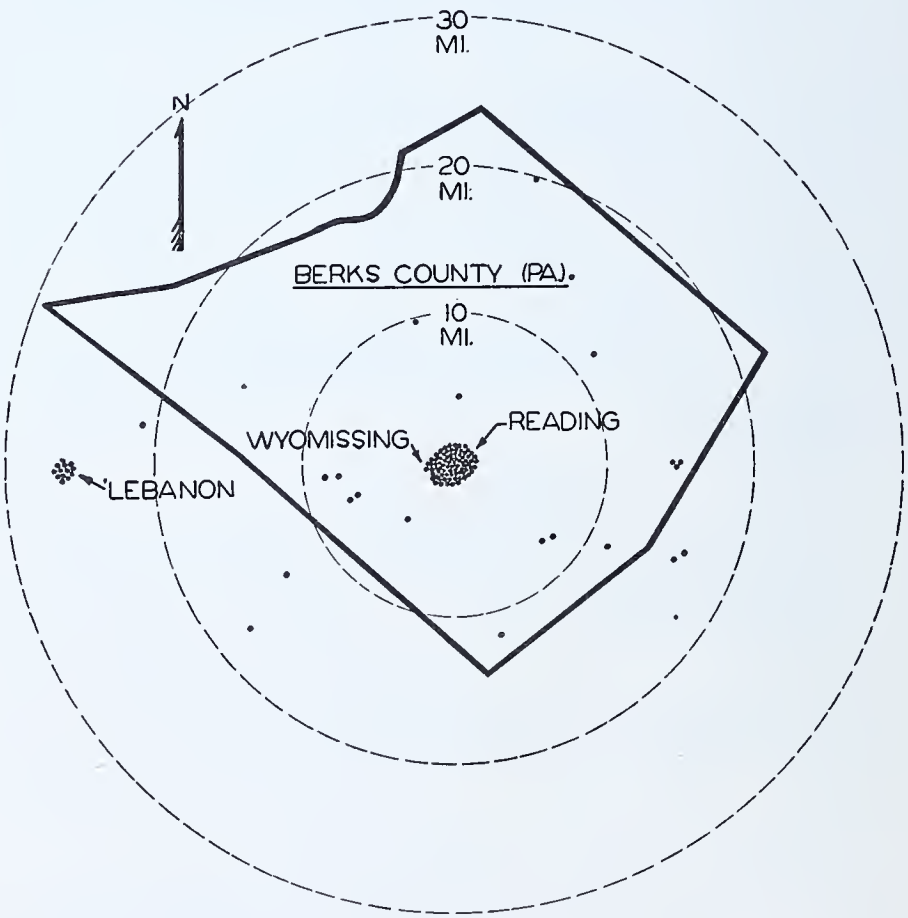


Figure 4—Homes of approximately eighty-seven per cent of the technical institute students enrolled at the Wyomissing Polytechnic Institute in 1936-1937.

Significant facts in connection with the Wyomissing Polytechnic Institute.

a. By far the larger number, seventy-three per cent, are enrolled in the technical institute program in preference to the junior college program, shown above.
b. The above preference exists in spite of the fact that there is practically but one curriculum—general basic technical, see paragraph 10—available in the technical institute part of the institution.
c. More than seventy-two per cent of the students came from Berks County and approximately eighty-seven per cent came from within a radius of thirty miles, which is about the farthest point of any part of Berks County from Wyomissing.
d. Apparently 133 students, most of whom came from Berks County, want this type of technical institute education sufficiently to pay $80 per semester for it.
e. At least these facts are significant since they indicate the demand to be for the technical institute or career type of education in preference to the junior college type, that the numbers enrolled exceed the estimates made in the technical institute study for equal population, and that these technical institute students are willing to pay at least a part of the cost of such education.
f. The Evening School, as a part of the Institute, is attempting to supply the educational needs of the adults of the community with courses especially suited to the employment needs of this community.

Had the Wyomissing Polytechnic Institute been in existence when the Report on Technical Institutes was written it probably would have been cited as a fine example of an institution offering a general basic course showing the possibilities for this type of education and for general basic technical courses in Pennsylvania.

At this time, we might examine a variety of typical curricula from the technical institute area of education, which might also be termed upper secondary career education and preparation.

CURRICULUM OF THE WYOMISSING TECHNICAL INSTITUTE

First Year—First Semester	*Hours Per Week* *Class*	*Lab.*	*Total*
Inorganic Chemistry	3	3	6
Physics—Mechanics	5	6	11
Engineering Drawing	0	6	6
Trigonometry	6	0	6
Shop Theory	2	0	2
Hygiene	1	0	1
	17	15	32

First Year—Second Semester	*Hours Per Week Class*	*Lab.*	*Total*
Inorganic Chemistry	3	3	6
Heat, Light, Sound	4	3	7
Descriptive Geometry	3	5	8
Analytical Geometry	6	0	6
Composition	3	0	3
Principles of Economics	3	0	3
Shop Theory	2	0	2
	24	11	35
Second Year—First Semester			
Qualitative Analysis	2	4	6
Electricity and Magnetism	3	3	6
Engineering Drawing	0	6	6
Elementary Mechanics	5	0	5
Applied Mechanics	3	0	3
Principles of Economics	4	0	4
Shop Theory	2	0	2
Composition	3	0	3
	22	13	35
Second Year—Second Semester			
D. C. Theory and Machinery	4	6	10
Kinematics	4	4	8
Strength of Materials	5	0	5
Corporation Finance	3	0	3
Shop Theory	3	0	3
Empirical Design	0	3	3
Business English	3	0	3
	22	13	35
Third Year—Final Semester			
A. C. Theory and Practice	4	3	7
Machine Design	5	6	11
Empirical Design	0	3	3
Industrial Management	4	0	4
Heat Engines	3	0	3
Knitting Machinery or M. E.	6	0	6
	22	12	34

2. OTHER INSTITUTE PROGRAMS

Cooperative Retailing Program—Rochester Mechanics Course

First Year *Courses Common to All Curricula*	*Hours Per Wk.*
Color and Design	5
Principles of Retailing	4

	Hours Per Wk.
Retailing I	6
Corrective English	2
Textiles	2
Orientation	2
Physical Education	2
Remedial Mathematics	1
Special for Retail Distribution	
Psychology	4
Second Year	
Courses Common to All Curricula	
Fashion Trends I	4
Merchandising	4
Retailing II	2
Financial Operations	2
Costume Coordination	5
Physical Education	2
Second Year	
Courses Common to All Curricula	
Sales Promotion	2
Display	2
Special for Retail Distribution	
Modern Social Problems	3
Current Events	2
Third Year	
Courses Common to All Curricula	
Retailing III	3
Personnel Relationships	3
Philosophy	3
Physical Education	2
Special for Retail Distribution	
Planning and Control	4
Fashion Trends II	2
Interior Decoration I	5
Appreciation of the Arts	3

MECHANICAL DIPLOMA COURSE—LOS ANGELES (JUNIOR) COLLEGE

First Year	*Alpha Semes.*	*Beta Semes.*
English	3	3
Engineering Calculations	3	
Engineering Problems		3
Engineering Drawing	2	
Machine Drawing		2
Plane Surveying	4	

	Alpha Semes.	*Beta* Semes.
Electricity		4
Mechanics	4	
Mechanical Laboratory		1
Manufacturing Processes		2
Health		2
Physical Education	½	½
	16½	17½

Second Year	*Gamma* Semes.	*Delta* Semes.
Social Science	3	
Government of the U. S.		3
Engineering Analysis	3	
Elementary Hydraulics		2
Engineering Physics	3	3
Descriptive Geometry	2	
Machine Design		3
Materials of Construction	3	
Mechanical Laboratory		1
Heat Engineering	3	
Materials Testing		1
Refrigeration and Air Conditioning		3
Physical Education	½	½
	17½	16½

TWO-YEAR CURRICULUM IN THE COOPERATIVE POWER LAUNDRY COURSE —OHIO MECHANICS INSTITUTE

Subjects—1st Year	*Subjects—2nd Year*
Theoretical Chemistry	Applied Chemistry
Show Work	Heating and Ventilation
Laundry Technology	Laundry Technology
Business English	English Conferences
Cost Accounting and Business Practice	Laundry Accounting
	Advertising and Salesmanship
Steam Engineering	Strength of Materials
Elementary Electricity	Elementary Electricity
Textile Fabrics	Economics

School Weeks Per Year	20
Work Weeks Per Year	20

ELECTRICAL TECHNOLOGY DIPLOMA CURRICULUM—PASADENA JUNIOR COLLEGE

	Sem. I	*Sem. II*
Freshman (Grade XI)		
Physical Science	4	4

	Sem. I	*Sem. II*
Algebra	4	4
Humanities	4	4
Orientation	1	
Instrumental Drafting	2	2
Processes, Production, or Electrical Laboratory	2	2
Physical Education or R.O.T.C.	1	1
	18	17
Sophomore (Grade XII)		
Social Studies	4	4
Physics	4	4
Slide Rule		1
Trigonometry	4	
Production Drafting	2	2
Processes, Production, or Electrical Laboratory	2	2
Physical Education	1	1
Composition	2	2
	19	16
Junior (Grade XIII)		
Industrial Electricity	5	5
Applied Electrical Theory	3	3
Electrical Drafting	2	2
Technical Mathematics	4	
Applied Mechanics		4
Technical Reports	2	2
Physical Education	1	1
	17	17
Senior (Grade XIV)		
Industrial Electricity	5	5
Applied Electrical Theory	3	3
Electrical Drafting	2	2
Materials Testing Laboratory	2	2
Strength of Materials	3	3
Industrial Organization	2	2
Physical Education	1	1
	18	18

TWO-YEAR CURRICULUM IN FOUNDRY MANAGEMENT AND OPERATION—WENTWORTH INSTITUTE

First Year	*Total Clock Hours*		
	Class	*Lab.*	*Total*
Applied Science	45	90	135
Electricity	60	120	180

	Total Class	*Clock Lab.*	*Hours Total*
Steam	45	45	90
Mechanical Drawing	0	180	180
General Chemistry	30	60	90
Mathematics	120	0	120
English	30	0	30
Shop Practice in Foundry	30	195	225
	360	690	1050
Second Year			
Chemistry	60	180	240
Electricity	45	45	90
Mathematics	60	0	60
Drawing	0	90	90
Materials	30	30	60
English	30	0	30
Shop Practice in Foundry	60	420	480
	285	765	1050

Data:

Total Clock Hours—Two Years	2,110
Weeks per School Year	35
Clock Hours per Week	30

3. LOGICAL CENTERS IN PENNSYLVANIA

In order to examine further the possibilities in Pennsylvania, perhaps we might consider for study and analysis the first and second class school districts as logical centers of population, most of them being predominantly industrial in character.

First Class School Districts (see Chart)

Philadelphia

Pittsburgh

Second Class School Districts

Allentown
Altoona
Bethlehem
Chester
Easton
Erie
Harrisburg
Hazleton
Johnstown
Lancaster
Lower Merion
McKeesport
Newcastle
Norristown
Reading
Scranton
Upper Darby
Wilkes-Barre
Williamsport
York

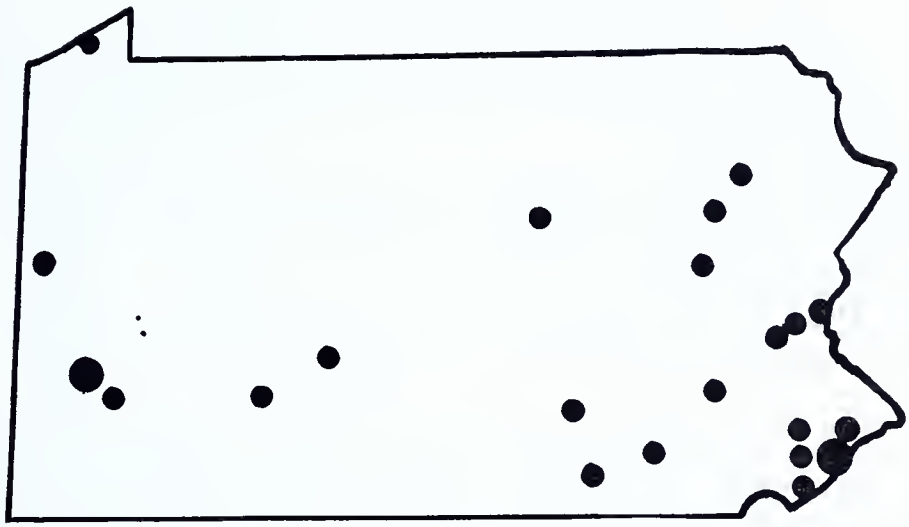


Figure 5—Location of First and Second Class School Districts in Pennsylvania.

PHILADELPHIA'S NEEDS

A partial analysis to show the potential field for Technical Institute education in Philadelphia was made in the Technical Institute Report, pages 81-83, showing the predominating manufacturing industries, the number of manufacturing concerns, and the number of employes.

MANUFACTURING IN PHILADELPHIA

8 Largest Groups	*No. Concerns*	*No. Employed*
Textiles	1,522	87,109
Paper and Printing	796	23,598
Machinery	356	22,854
Foods and Products	935	17,940
Leather and Products	143	9,449
Iron and Steel	164	8,170
Lumber and Products	293	7,346
Other Groups	1,139	51,983

The Manufacturing in Philadelphia is fairly diversified in type and character.

Based on previously determined ratios, manufacturing alone in Philadelphia should have in its employ about 50,000 technical institute graduates in order to operate most efficiently. Thus, the annual replacement requirements for manufacturing in Philadelphia would be about 450 to 500.

WILLIAMSPORT'S POSSIBILITIES

Going from the largest city in the State to Williamsport, with approximately 50,000 population, we again find diversity of manufacture—

Five Largest Groups	*No. Employes*
Metals and Metal Products	2,550
Textiles and Textile Products	2,515
Lumber and Its Products	1,282
Paper and Printing	1,108
Leather and Leather Goods	1,090
Miscellaneous	2,255
Total in Manufacturing	10,800

Based on previous findings, *Williamsport manufacturers alone* could use effectively approximately 700 technical institute graduates, which would require an annual replacement of approximately twenty to twenty-five.

Besides manufacturing, in both Philadelphia and Williamsport, other fields of employment would offer opportunities for Technical Institute prepared persons—

4. SUGGESTED CURRICULA

Do the following curricula, for career education, already offered elsewhere suggest possibilities in Pennsylvania?

a. ARCHITECTURE

For work with architects, engineers, builders, landscape architects, and related fields.

b. ART

For work in advertising, industrial design, fashion illustration, costume design, stage design, interior decoration, window display, etc.

c. BUSINESS AND ACCOUNTING

For work eventually in the fields of public or business accounting and costs.

d. BANKING

For beginning work in commercial banks, savings banks, trust companies, savings, and loan associations, etc.

e. FINANCE

For work in such fields as stocks and bonds, credits and collections, insurance, real estate, corporate finance, etc.

f. Management
For those going into business for themselves, or for advancement in their present positions.

g. Merchandising
For work in advertising, selling, retail buying, marketing, etc.

h. Civic Health—Doctor's or Dentist's Assistants
For work as reeeptionist or assistant in these offices, etc.

i. Public Service
For work in assessing, taxes, government, etc.

j. Building Construction

k. Electricity—Radio—Sound

l. Electronic Applications in Industry

m. Hydraulic Controls and Appliances in Manufacture

5. SUGGESTIONS FOR SUCCESS

Based on many experiences, to be assured of the best ehances of sueeeeding, various factors should be considered in the installation of teehnieal institute instruction.

The Administration

Should have experience in both praetical work and teaching.

Should be in sympathy with this type of edueation and enthusiastic over its results.

Should most usually not be the same administration as that of the senior high sehool—the problems and atmosphere are different.

The administration should report directly to the superintendent of schools, as the administrative offieer of the sehool system.

The Faculty

In general, the faeulty should not be the same as that used in the senior high school—more praetieal experienee is essential.

The faeulty should have practical as well as teaehing experience—if either must be omitted, it should be the latter.

It will probably be neeessary to pay the faculty higher salaries than those paid the senior high school teachers, beeause of the limited supply, broader education, and larger experience required.

Because of the nature of the work, men will likely have to predominate on the faeulty. Standardization of faculty qualifications should be at a minimum for effeetiveness, and yet adequately proteet quality.

The Equipment

Technological courses will require shops and laboratories—these are vitally important in this type of education.

In certain locations or cities existing shops and laboratories might be used jointly.

At the same time, many non-technological courses will not require extensive equipment.

The Finances

Sources of finances in other parts of this country for this area of education, are—

A. Endowments
B. State subsidies—for example, in California $50 per student per year
C. Local public funds
D. Tuition fees

The Curricula

A number of typical curricula have been shown, but local facts should determine the character of offerings for any city or section. For example, in a section where textiles predominate the program at least should supply these needs.

As a rule, the curricula are briefer in length, more intensive in work, more directly vocational, and pointed more definitely toward specific objcetives than are the usual four-year college courses. Naturally, they will need to be revised and brought up-to-date frequently by reason of their technological character.

The Entrance Requirements

Should be more flexible than are the usual requirements for entrance into the usual four-year college. The guiding factor should be: can the person succeed and profit by the work. While the current practice is not absolutely to require senior high school graduation, yet experience shows at least the equivalent of such graduation to be essential.

On the other hand, for certain brief, intensive, and practical courses, which should be a part of most of these programs, the entrance requirements should fit the courses in question.

Graduation

Some form of certification will be essential and this will be a vital problem in maintaining or preventing this type of education from transforming or evoluting into other fields or types. Much thought should be given this problem.

Nomenclature

The name Technical Institute does not adequately describe the education being discussed; it is not sufficiently broad to include business, semi-professional, spare time, and other courses, all of which should be included in a well-rounded program in this field and at these levels.

The following names have been suggested, by various persons, for this education and preparation—

Technical Institute
Polytechnic Institute
Career Institute
Collegiate Institute
Institute of Technology
Technological and Business Institute
Institute of Business and Technology
Technical and Business Institute
Community Institute
Community Career Institute
Business and Industrial Institute

It is apparent that most of these are either not truly descriptive or conflict with names already in common use for other types and fields of education.

6. CAREFUL STUDY ESSENTIAL

Any development in this field of education in Pennsylvania, particularly in public education, should receive the closest study and the broadest consideration, making extended use of what facts are already known. It is something that cannot be put into effect over night and be expected to produce the best results.

Cities or communities contemplating making such a program available to meet their real needs should first know fairly accurately those needs. An analytical community survey of the real educational needs is usually highly desirable to eliminate the possibility of error in judgment or of getting off on the wrong foot. Guesses or personal opinions are never as good as are the facts.

With local facts and conclusions available, it means next a sound plan of procedure. In smaller centers of communities, it may necessarily mean small beginnings, while in the larger centers or communities complete units or institutions may be the only practical answer. In other cities or centers it may be found that the needs are already fairly adequately supplied through present existing institutions.

7. EXPERIMENTAL BEGINNING SUGGESTED

As a practical beginning for this type of education in the field of public education in Pennsylvania, my personal advice would be to center attention upon, perhaps, not more than two developments, in as many centers or communities, for the immediate present.

Needs, experiences, and results could thus be watched closely which would serve to point the way to other developments on a sound and effective basis. Many errors and pitfalls would in this way be avoided which would be bound to occur in widely scattered developments.

For such immediate developments, I would suggest centers or communities with somewhere in the neighborhood of 50,000 to 75,000 and of 100,000 to 150,000 population respectively, both to have diversified business and industry. For this purpose, it is needless to say that Philadelphia and Pittsburgh could not be considered typical communities.

For students who show vocational bents, personal likings, and individual characteristics favorable to technical institute or career education many feel that they should be started in this direction earlier than senior high school graduation or its equivalency. For example, the Pasadena Junior College, paragraph 14, operates on the four-grade plan, XI, XII, XIII, and XIV, in a continuous sequence, for both terminal and regular junior college programs. This plan has one thing, among others, to commend it—namely, that the smaller centers or communities will, in a number of instances, find sufficient volume to justify developments in this field of education. Particularly, in the smaller centers or communities I suggest that consideration be given to the inclusion, for selected students, of three (XII, XIII, XIV) and perhaps four (XI, XII, XIII, XIV) grades.

8. COOPERATIVE PLAN POSSIBLE

The cooperative plan, based on alternating periods of school work and employment is well adapted to the aims, environment, student ages, and levels of work of the post-senior high school. While the cooperative plan has both strengths and weaknesses it does ease the economic burden on both the student and the school and does extend the student's formal period of education. It likewise affords the student a trial of aptitude and a normal orientation to employment without a break in the continuity of the educational process. In some centers or communities the cooperative plan might not be a practical approach at all, but I would advise that at least consideration be given to it in every proposed development for post-senior high school education.

Many more details might be given which would have no place in a general presentation such as this one. So, before throwing the con-

ference open to discussion, may I repeat a statement made earlier—that facts evolved during the technical institute study forced the staff to one very definite conclusion, from which, individually or collectively, it has never wavered, to the effect that a further development of technical institute or career education, or by whatever name called, is badly needed in the United States, particularly in industrial areas such as Pennsylvania, for the important benefits it would bring to employes, employers, and communities alike.

I can say confidently that with the right knowledge of the local needs, with the right administration, with the right instructional staff, with rightly selected and guided students, with the right facilities, and with the right support in general, the right results will be forthcoming—results that actual experience has proved possible.

C. SYNOPTIC VIEW OF TECHNICAL INSTITUTE EDUCATION*

Present Status of Technical Education. Educational programs in this country which are designed to prepare young people for technical service in industry, using that term in its broadest sense, may be roughly classified in three types.

1. *Vocational Education.* Most of this is at the secondary school age level and is intended chiefly to prepare for specific vocations in particular divisions of industry, such as the building trades, printing, laundry work, etc.

2. *Technical Institute Education.* This is at the post secondary school age level and is intended to prepare for technological position of moderate degrees of responsibility in broad divisions of industry or commerce. It is more basic in nature than division (1) above, but is briefer and more practical than division (3) below. It is to be distinguished from junior college or pre-professional engineering education, though it is generally of about the same duration. It is essentially a terminal program.

3. *The Engineering College and Post-graduate School.*

Vocational Education has developed rapidly in the recent past, due in part to Federal support. More basically its extension has been due, however, to an awakening realization of the educational and societal needs of the large fraction of the population of secondary school age which is now in school.

The country has a well-established and extensive system of *engineering colleges,* to the number of about 160. This system is unique among higher educational systems of the world in this field: first, in its magnitude; and second, in the fact that it is almost exclusively an undergraduate system more academic than professional in nature. I should call it an "omnibus" system in that it satisfies a very con-

* Abstract from discussion by Dean H. B. Hammond, Pennsylvania State College, at a meeting on technical institute education, held in Harrisburg, November, 1938.

siderable variety of needs, both educational and industrial. Because it has a bearing on later remarks, I would say also that this complexity of ends attempted to be served places the engineering colleges of the country in an unsatisfactory position insofar as definiteness of purpose or specificity of aims is concerned.

Between the two foregoing levels of vocational education and of engineering education comes the great gap in the system of technological education in this country, a gap which is contrary on the one hand to industrial needs and on the other hand to the needs and abilities of our student population. A great deal has been said about the causes of this condition in the United States, but I think we need go no further than to ascribe it to the virtually universal popular conception that every young man and woman must follow an educational path which offers the opportunity of continuing clear to the end of the system, or at least to the baccalaureate degree. Our people on the whole are not willing, apparently, to recognize any distinctions either of class or of ability when it comes to educational programs, especially beyond the secondary school. I think it was Wendell Phillips who said that if the baccalaureate degree could be conferred on every child in this country at birth, the cause of higher education would be immensely benefited—a most penetrating observation.

It is interesting to note that it has been seriously proposed to confer the bachelors degree in engineering at the end of three years, or even two years, of college work, the purpose being to place the normal terminal point at a lower age level and thus to clear the decks for those who wish to go on to a more highly professional engineering objective. I do not believe that this proposal will get far, though it has occasional support in some industrial circles.

As I have said on a previous occasion, the path of engineering education in this country is strewn with the wrecks of technical institutes, though this may not be quite the right way to express the fact that many of the efforts to establish and sustain technical institute education have led eventually to the formation of the conventional four-year engineering college.

All the evidence points to the fact that the establishment and maintenance of the endowed technical institute in this country is surrounded with many difficulties, the least of which, perhaps, is initial financial support. I believe, nevertheless, that the time has come when concerted efforts to establish technical institute education ought to be renewed. The start should be made only under the most propitious circumstances of industrial and educational need, of financial support, and of interest in the problem by persons having the capacity to initiate such educational projects and to develop them to a successful condition of stability.

Evidence indicates that consideration must be given to all related factors, if the establishment of a technical institute is to be success-

ful. The following list indicates certain of the more important of these factors, though in each community there will doubtless be others:

1. Coordination with other parts of the educational system of the community; that is, technical institute education should be conceived of as a local or at most, a regional project.
2. Determination of local educational and industrial needs.
3. Relationship to the junior college program; that is, separation of the terminal and non-terminal types.
4. Course content.
5. The selection of text material, a most difficult problem. (In general, suitable text material remains to be developed in this field.)
6. Auspices. In my judgment technical institute education is most likely to succeed under public auspices, since this seems best to promise continuity of purpose. To keep the program on the track once established seems to be the most difficult feature of this type of education.
7. Selection of teaching personnel, a very difficult task since qualified teachers are scarce and usually have to be prepared on the job. It is especially important to insure against continuation of purely engineering college types of instruction and of subject matters, yet most of the teachers must be recruited from among engineering college graduates—hence the difficulty.
8. Selection of suitable personnel, probably the most difficult task of all.
9. The question of full-time or part-time adult programs.
10. Financial support. Technical institute education must not be conceived of as inexpensive. It is as costly, if conducted properly, as is the general run of engineering college work.

Can such type of education succeed in this country? If one were to judge from the history of a good many of the endowed schools which started with this purpose and later became full-fledged engineering colleges, and if one were to judge from the difficulties which certain of the schools now operating in this field are encountering, one might be inclined to be pessimistic. On the other hand, a number of examples may be cited which point in the other direction.

In a recent survey of adult technical education in New York City the following numbers of institutions of different kinds were listed as providing technical or engineering education at various levels for adults, chiefly through evening programs: seven colleges and universities; three technical institutes; four Y.M.C.A. schools; fourteen

secondary schools offering vocational programs; fourteen vocational schools, per se; and thirty-three proprietary schools of various types, including a number which offer programs in the field we are here considering.

Two things are significant about this list: first, the relatively small number of genuine technical institutes and second, the large number of proprietary schools that are able to flourish in this area. The word "flourish" is used advisedly since all such schools in order to survive must make both ends meet without the aid of endowment or subsidy. It is a fact that many of them are profitable, and a number of them are doing a very fair quality of work. A number of them are of the technical institute type and are separated from the other technical institutes in the classification merely because they are operated for profit. Why is it that such schools can operate successfully on this basis while the privately endowed schools so often cannot or do not? This answer is clear. They meet an actual need and a demand from students—because they keep their ear to the ground, so to speak. While no one would advocate that programs and standards be copied blindly, it seems clear that something may be learned from a careful study of institutions of this type.

The second example of highly successful institutions on the technical institute level is certain of the schools of aeronautics which have developed within the past few years, such as the Boeing School at Oakland and the Curtiss-Wright School at Los Angeles. These are among the most highly successful commercial schools, if that word may be properly used, in the world and they are also, I think it is fair to say, among the most successful educational institutions of *any* type in the country. Of course they are functioning in a field in which there is a tremendous popular interest. The country is swarming with young men interested in aviation, so that conditions for success are more than usually favorable. Nevertheless, if one would see an example of how sound and useful educational programs leading to particular objectives may be conducted, he might well direct his attention to these institutions.

Though it is of a personal nature, I should like, in closing, to affirm my chief reasons for interest in this problem: first, because from some knowledge and interest in the general field of technological education I see in the technical institute both a major educational lack and a great educational opportunity; and second, and more selfishly, perhaps, because from the standpoint of the engineering college the development of technical institute education would in all probability cause our problems of aims, purposes, and methods to be greatly simplified.

II. TECHNICAL INSTITUTES OF NORTHERN EUROPE*

A. TECHNICAL INSTITUTE AT COPENHAGEN

Education is compulsory for all children in Denmark from their seventh to their fourteenth years. Practically every child receives its education in schools staffed with highly-educated teachers and the instruction provides a good foundation for general cultural development and also for the many different forms of advanced education available to the individual citizen.

For craftsmen this advanced education includes first and foremost systematic education for apprentices at technical schools, of which there are about 300 spread over all parts of the country—a large number compared with the extent of the population, about 3,600,000. This education is carefully framed to suit the age and development of the apprentices, and is designed not only to teach them the technicalities of their trade but also to impress them with an intelligent understanding of the nature and purpose of their work.

1. NEED FOR EDUCATION OF MASTER

Up to three decades ago there was no real education for the master —the craftsman or the man who owns and runs a production plant on a small scale. In large industries, where distribution of labor is possible, educated men may be employed to look after the commercial side of the business and engineers to see to the purely technical work, but in the smaller establishments any such distribution is hardly practical. The master man and the small industrialist, who have to combine in themselves capacity for the dual tasks of commerce and technique, formerly lacked commercial education, and they had no possibility of supplementing technical knowledge of their trade through instruction or by having access to expert advice which could keep them on a level with developments.

Though the preparation of craftsmen—the workmen—may be said to have been good, perhaps equal to the best in the world, there was in Denmark thirty years ago very little instruction for master men. During the whole of his career there is no step a craftsman can take in which a thorough understanding in the tasks that lie before him are of more vital importance to him than is the case when he is about to establish himself on his own account, taking out a trading license or starting a factory for himself. Although it is true that the completion of the test that follows a craftsman's apprenticeship—an occasion of much festivity in Denmark—marks the close of a very important period, it is actually of little significance beyond making

* Adapted from an article in the Danish Foreign Office Journal by M. Gunnar Gregersen, Director of the Institute of Technology, Copenhagen.

possible a different scale of wages and bringing a step up from the ranks of youth to those of the more responsible adult. A more critical step comes with the change-over from worker to master, for then the handworker becomes the calculator and the administrator. Many have failed at this step. Many a young master with good qualifications as a craftsman has failed owing to his lack of business knowledge, and the cost of the "school of experience" has been protested bills, arrangements with creditors, or bankruptcy.

2. BEGINNINGS

At about the beginning of the present century the endeavors then being made to give craftsmen some guidance, particularly in commercial matters, prompted the Joint Representative Organization of Danish Handicraft and Industry to discuss plans for the starting of a technological college. In the course of a few years these plans crystallized and, thanks to the initiative taken by the Joint Organization and by the Federation of Danish Industries, the Institute of Technology was founded in Copenhagen in 1906, with the subsidiary title of the Trade School for Craftsmen and Minor Industrialists, and with the tasks of providing courses for masters, giving advice to craftsmen, and organizing trade exhibitions.

On this basis the Institute has been built up and it has grown so strong and so large that now, on the completion of the thirtieth year of its activities, it can look back with pride on its development from forty-two students, a debt of 500 Kroner, and no regular staff of officials in 1906, to an annual student roll of 8,252, an aggregate of 601.654 instruction hours, a capital of over three mill. Kr., and a regular staff of over 100 engineers, workshop leaders and office personnel in 1936.

3. AIMS OF THE INSTITUTE

The Institute concentrates mainly on master-training and on technical advice to craftsmen, etc. It has nothing to do with apprentices or their instruction, the instruction aiming solely at the technical and commercial efficiency of the skilled worker. It comprises day courses and evening courses, ranging from one to ten weeks. These courses are generally held in the Institute's own building in Copenhagen, but the past few years have seen the commencement of extension courses for special trades in the provinces, held in the big towns and mostly in ordinary workshops. The intention is to give workers who cannot attend the Institute in Copenhagen an opportunity of getting the same instruction in certain restricted branches—for example oxy-acetylene welding—as is given at the Institute itself.

It is regarded as of the greatest importance that the instruction should be kept as close to practical life as possible; it is given mostly

in the Institute's many workshops, and mainly comprises workshop tasks and instruction as well as a knowledge of materials and methods. Large numbers of the instructors are themselves skilled craftsmen who, apart from their teaching activities at the Institute, earn their livelihood in the practical exercise of their craft, so that the instruction they give is really "actual" and is imparted in the everyday language of a working craftsman.

Alongside of the practical work, bookkeeping and calculation of costs, etc., also form important parts of the instruction, and the worker is helped to realize that under present social and labor conditions mere production is not sufficient in itself: the producer must also be able to sell his products and to make a reasonable profit on them and hence also on his labor. To this end the craftsman must necessarily be able to make his own calculations of manufacturing costs, etc.

4. RESEARCH WORK AND ADVISING

During the first years it was mainly the instruction that kept the Institute going and established its name. This is still its principal concern, but research work and advising—the so-called "Craftsman's Consultation"—which were started in 1919, are steadily growing in importance. The Craftsman's Consultation is divided into various sections, for smiths, tailors, joiners, gardeners, painters, building workers, bakers, butchers, etc., and for persons seeking information in regard to the electromotor, the motor, the automobile, chemistry, heating, acoustics, bookkeeping, etc.

Advising and guiding, answering inquiries regarding new means and methods of production, and endeavoring to create new fields of production for Danish industry and crafts, form the main object of this part of the work of the Institute.

Its engineers and regularly employed craftsmen act as counselors. For a small fee the working craftsman of Denmark may consult a counselor on such questions as manufacturing methods, bookkeeping, the examination of materials and their suitability for particular purposes, etc., and both questions and answers may be either in writing or verbal. Also for a low charge a craftsman in any part of the country may call in a counselor for personal discussion and investigation on the spot.

This technical advice has proved to be extraordinarily useful to the individual cratsman and small industrialist, and corresponds essentially to facilities that for years have been open elsewhere to the Danish agriculturist and the larger industrialist.

A publishing office run in conjunction with the Craftsman's Consultation issues handbooks for smiths, electricians, joiners, painters, plumbers, etc. These books are based on the requirements of practical life, and they deal with the technical sciences in such a way that

they can be understood by any ordinary intelligent craftsman. These books enjoy a wide distribution in Denmark, as well as among Danes living abroad, with many of whom, it may be remarked, the Institute is constantly in communication.

There is a free reading library at the Institute, but the books are not lent out. A large collection of trade journals is available; many of them are in foreign languages, and thanks to the language lessons given at the Institute's evening school many of the readers are able to master what this foreign literature has to teach them. About 8000 people visited the library in 1935.

5. SUPPORT

The Institute of Technology is a self-supporting college for the whole country. The funds are obtained partly from grants by the State and by the municipal authorities of Copenhagen and other towns, and partly from contributions received from the organizations responsible for starting it, as well as from other trade institutions, legacies, and private gifts. Considerable sums also come in in the form of school fees and consultation fees. These fees are charged for economic and pedagogic reasons, the experience of the Institute being that craftsmen—like most other people—are inclined to think that "what costs nothing is not worth much." This attitude was well illustrated during a period of severe unemployment, when one course was doubled so as to admit as many free students as there were paying students. All of the latter completed the course, but of the free students more than three-fourths gradually dropped off.

From the Institute's latest balance sheet it appears that in 1935-1936 there were 8,252 students and 12,566 consultations. The State contribution amounted to 439,200 Kr., other contributions to 3,116,000 Kr., while receipts from school fees, consultations, etc., totaled about 760,000 Kr.

6. MANAGEMENT

The management committee consists of the director and twenty-four members, of which the State through the Ministry of Trade, Industry, and Shipping elects five, the two founder-organizations six each, the Craftsmen's Societies in Copenhagen and the Amalgamated Trades Unions three each, and the Corporation of Copenhagen one. The director of the Institute is ex-officio member of the committee.

In the thirty years which have gone by the Institute of Technology has grown from a small and almost unknown to a large and extensively recognized establishment, and to the Danish public it now stands as a valuable factor in the trade and industrial life of the country.

Instruction in properly equipped workshops has great advantages over classroom instruction. The students benefit much more by carrying on experiments for themselves than by merely sitting and watching demonstrations. Matters of actual and present professional value are explained and discussed, while things that are only of scientific interest are avoided. This means that much of the instruction takes the form of 'translations" of technical details and scientific facts into the everyday language of the worker. There is a constant unobtrusive influence directed towards helping the student to understand the great significance of finding pleasure as well as occupation in his work. The benefits of intercourse with other students and workers, and the gratification of serving the entire community in all that one does are brought home, as is also the destructive power of concentration on profit-hunting. Not infrequently craftsmen have left the Institute with a feeling of deep gratitude, both for the technical knowledge they have acquired, and, as one of them once expressed it: "because I think I have found something more: I have learned to appreciate the privilege of being a craftsman."

B. THE TECHNICAL INSTITUTE AND THE DEVELOPMENT OF NEW INDUSTRIAL LINES

1. TERRITORIAL CONQUEST

One sphere among the activities of the Institute of Technology that is particularly interesting is what is called "territorial conquest," by which is understood the capturing of new fields of operation within Danish handicrafts and the lesser industries. Whereas the larger industries often have their own laboratories, which in many cases have research work of this kind on their programs, the smaller industries will rarely, and the handicrafts almost never, find such work possible without assistance. Perhaps it may sound curious to speak of territorial conquest and research work for handicrafts, but with the developments through which they have passed during the last generation—the introduction of the electro-motor and modern machine tools—the crafts have, so to say, been industrialized, and many craftsmen have devoted themselves to particular specialties without their work losing its character as a craft. Sometimes the particular specialty has been taken up merely as an "intermediary job," i.e., work which can be taken on between the actual seasonal periods and so help to keep up the normal employment of the establishment, enabling the master to retain his skilled workers and to increase his turnover to meet overhead charges. As examples of these "intermediary jobs" there may be mentioned wood articles, such as shoeheels, pencil boxes, penholders, special moldings, etc., and iron articles such as spare parts for agricultural machinery, small building accessories, and so on. It can happen that these side-lines grow to

such an extent that the workshop gradually develops into a purely specialist establishment, which may even have a possibility of extending into something big. This, indeed, has been the case with some of those who took up wooden heels (ladies' heels), and they have succeeded in building up a very large export business, Danish beechwood having proved to be a very fine material for this purpose.

In many cases the Institute of Technology has lent a hand in the organization of small industries of this kind, which has been possible because in its workshops there is an unusually comprehensive collection of machine tools of the most varied kind, and because the Institute staff has obtained very considerable experience in this research work in the course of time. Experience in practice has shown that here, too, good cooperation has been of vital importance in the results achieved. The scientifically educated engineer who can deal with the theoretical side of the matter, making the calculations, drawing up the designs, and examining and testing the materials, must walk hand in hand with the craftsman and his practical work. The economic side of the venture can be thoroughly investigated in conjunction with the Institute's Bookkeeping Consultation, which has especially adapted itself for analysis of workshop economy.

2. STUDYING THE PROBLEM

As a general rule, reconnoitering for a new "territorial conquest" will begin with the examination of a sample of the article to be produced. The material of which it is made will be analyzed in the laboratories, and similar materials will be procured and tested. Information is also sought as to foreign market conditions for the article to be produced and anything else that may have a direct bearing on the possibilities of starting manufacture. If the inquiries are satisfactory, and the raw materials are procurable, attempts are made to produce a similar article, first on a small scale with the available machines, which, if necessary, may be fitted with extra devices for the purpose. If the production so far seems favorable, the inquirer will often wish to continue entirely on his own account. Experience has taught, however, that it is a very wide jump from the production of the first samples to mass production for sale, and therefore the Institute prefers, where possible, to follow up all subsequent developments. When mass production is decided on, the necessary manufacturing apparatus is constructed and a trial production is subjected to very careful examination throughout all the different operations in order to obtain exact data as to time and economy, and at the same time the consumption of materials, powers, etc., is exactly calculated. After any reconstruction or improvements these investigations may have suggested as desirable it is possible to draw up a reliable account of costs and profits, and to see whether the venture can be made to pay and will have a reasonable chance against competitors.

Research work of this kind may sometimes be concluded in the course of weeks or months, or it may take years. Badminton shuttles and insulation sheeting are now being produced in Denmark as a result of research work conducted at the Institute, which worked out the technique from the very bottom and designed the necessary machinery. The making of badminton shuttles, which necessitates a good deal of hand work, is now in its third year in Denmark, and the Danish product has proved to be able to hold its own both as to price and as to quality, and both at home and on the export markets. It is an article that requires relatively little machinery—which can be quickly depreciated within a short period—and has considerable possibilities.

3. UNENDING EXPERIMENTATION

The production of wood fibre sheeting is the result of almost five years' experimenting—the last two being taken up in arranging and testing the plant, which has now been running night and day since last spring with complete satisfaction. The raw material used is wood obtained from thinning out the health plantations, and difficult to utilize for other purposes on account of its small dimensions. The type of plant used in the Danish works is quite different from that required in the systems of production adopted abroad, which can only be based on very large outputs. The essential factor in the making of this new article of industrial conquest of Denmark is that the system evolved can also be adapted to a small output without enhancing the cost of production, while it is correspondingly cheap to install. The Danish method has also attracted interest abroad.

4. WIDE SCOPE OF SERVICE

Among other examples of new lines mention may be made of the manufacturing of spirit-levels, sulphonated oils for tanning, sawblades, liquid polishes and other technico-chemical articles, sanitary fittings for bathrooms, separators for accumulators, condensers for wireless sets, welding powders, lipsticks, sinkerchains for fishing nets, mechanical pencils, gelatine, capsules, bicycle wheel spokes, and paper clips.

These examples are eloquent of the varied nature of the research work done at the Institute. In regard to assistance given for special production methods, such as those outlined above, it has been found natural and most just to agree that the experience gained should be available only to the inquirer who makes the proposal, but in that event the inquirer must bear the total cost, either by paying a lump sum or agreeing to a license fee. The latter method has the advantage to the inquirer that he does not have to pay at once—often a matter of difficulty, as some starting capital is always required—and

on the other hand, it gives the Institute a larger share in the income from the new article it has itself helped to make possible of production.

It may be mentioned that the Institute frequently receives from Danes living abroad inquiries for technical information of various kinds, and sometimes they call on the leaders of the Institute when they are home on a visit. Instances could be quoted of Institute assistance given to laundry owners in Finland, Poland, and the Straits Settlements, of help in the canning of liverpaste in U. S. A., of advice to Danes in the Argentine as to literature on salt works and in Roumania on rice-starch making, while the Institute laboratories have deodorized fish oil from Siam for the making of soap, and made photo-litho paper for use in Brazil. Danes everywhere are invited to seek the collaboration of the Institute in any technical problem.

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